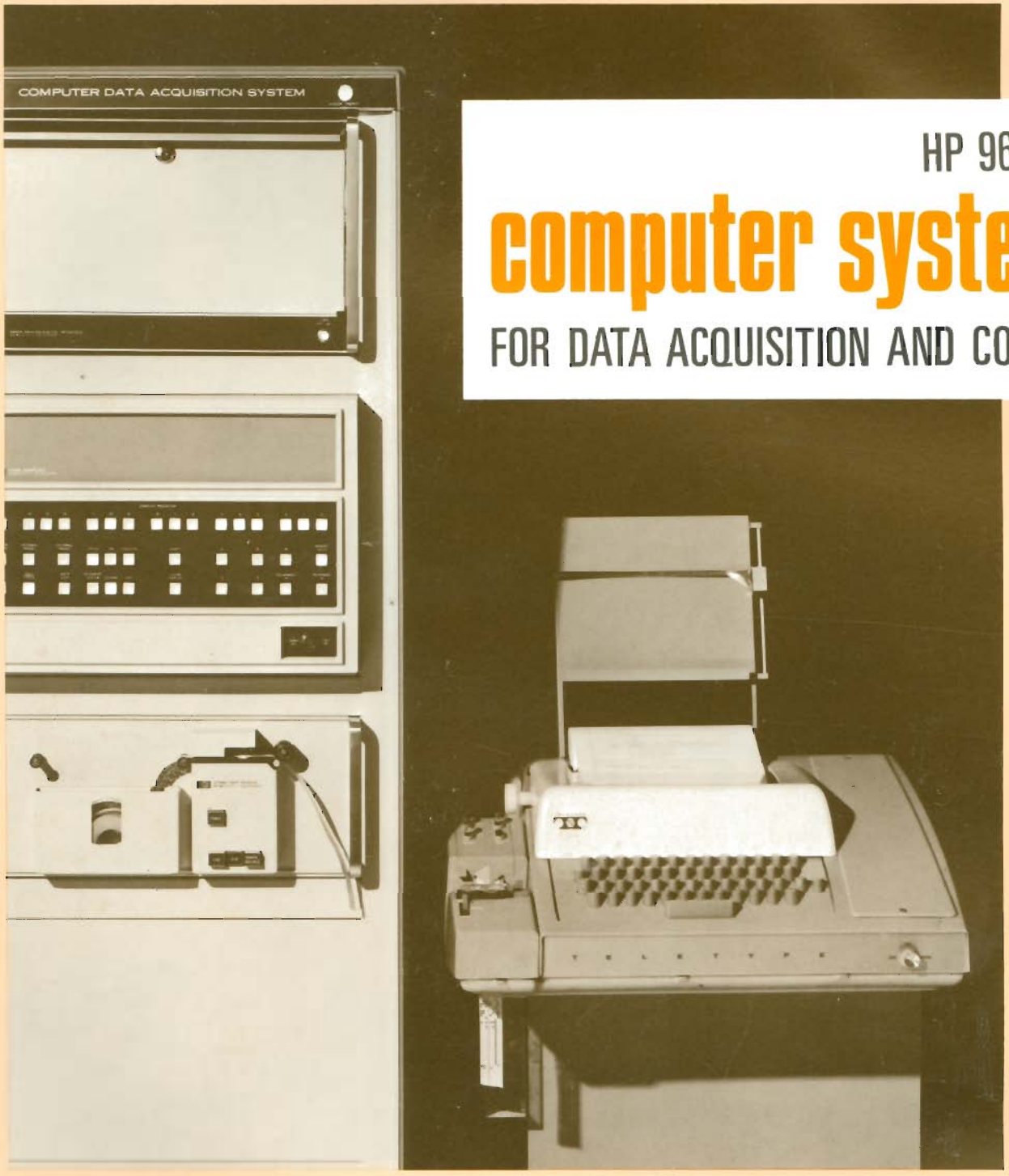

HP 9600A/G

computer systems

FOR DATA ACQUISITION AND CONTROL

HEWLETT hp PACKARD

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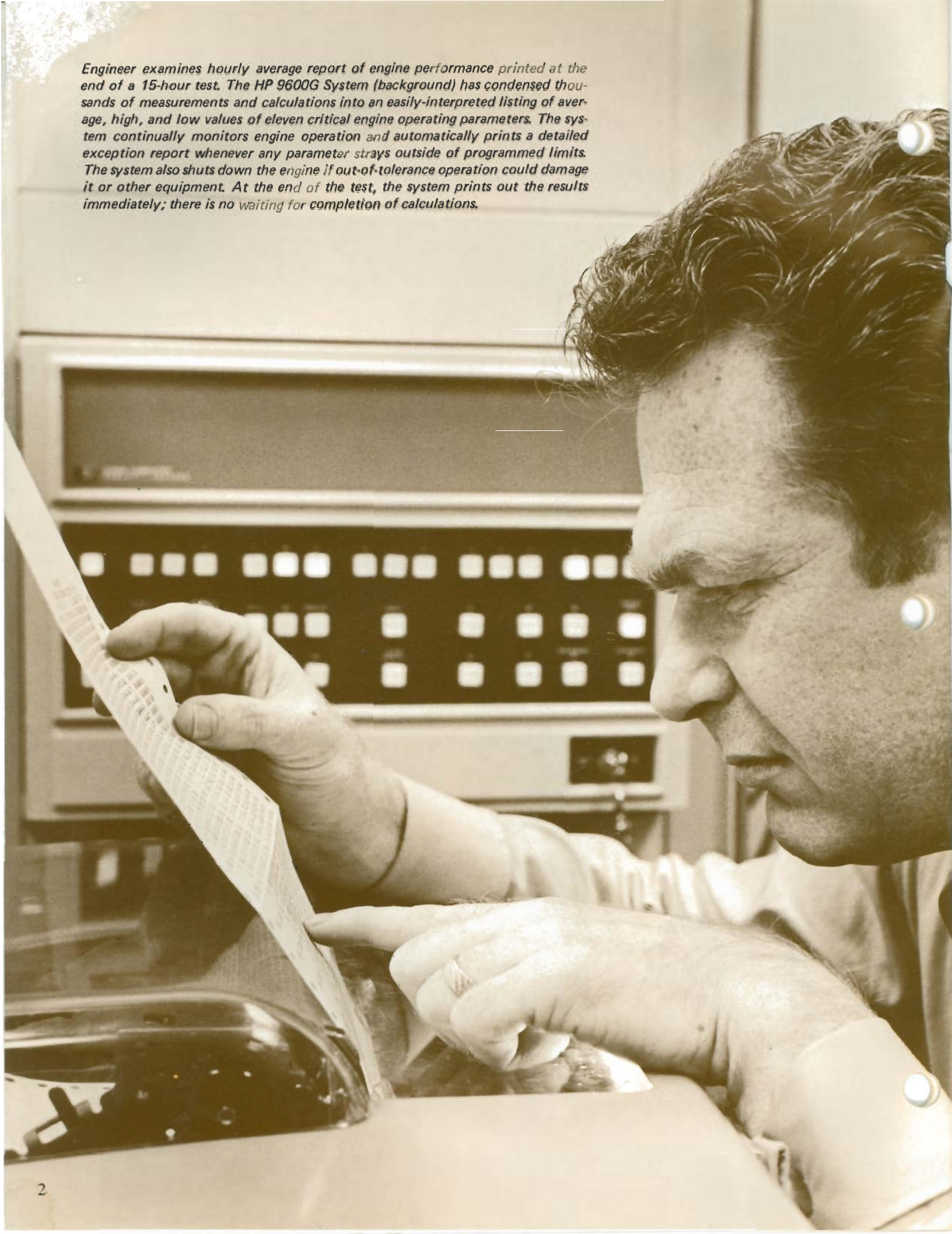


Engineer examines hourly average report of engine performance printed at the end of a 15-hour test. The HP 9600G System (background) has condensed thousands of measurements and calculations into an easily-interpreted listing of average, high, and low values of eleven critical engine operating parameters. The system continually monitors engine operation and automatically prints a detailed exception report whenever any parameter strays outside of programmed limits. The system also shuts down the engine if out-of-tolerance operation could damage it or other equipment. At the end of the test, the system prints out the results immediately; there is no waiting for completion of calculations.

HP 9600A AND HP 9600G SYSTEMS

—— *The Talent Liberators*

The HP 9600A and HP 9600G are computer-based automatic systems for data acquisition and control. These systems automatically measure, process, and log the data you need, freeing you and your people to develop new ideas and to refine and improve techniques, increasing your productivity.

The HP 9600A Basic Control System is supported by a comprehensive library of mathematical and service subroutines and coordinated by an operating system that promotes efficient use of all system resources (measuring instruments and input and output peripherals). Upon operator command, the 9600A System executes a program or a series of linked programs and related subroutines.

The HP 9600G Data Acquisition and Control Executive System (DACE) extends the capabilities of the HP 9600A System to include real-time scheduling of system operations. With DACE, the operator can schedule the entire data acquisition job and can use the executive's supervisory capabilities to determine subsequent system operation as a result of on-line computations.

These systems:

- Coordinate stimulus and measurement actions of the subsystems used for acquisition of analog data from thermocouples, strain gages, pressure transducers, and other physical sensors, and for conversion of that data to digital form.
- Correct the data for known errors of the physical sensors and instrumentation subsystems, thereby improving the accuracy of measurements.
- Convert the data to meaningful scientific and engineering units and calculate efficiencies, flow rates, heating trends, statistical distributions, etc., so that results of tests and experiments can be evaluated and acted upon immediately.
- Check results against limits and initiate appropriate action (warning to the operator or automatic shutdown) which can be used to stop runaway conditions and to protect equipment and personnel.
- Output the data on printout, display, punched tape, magnetic tape or any combination of these, as best suits the requirements of the application.

The HP 9600A and HP 9600G Systems can be equipped with a wide variety of instrumentation capabilities, including:

- Integrating analog-to-digital subsystems that get accurate readings of your low-level transducer signals, even when they're buried in high-level noise.
- High-speed analog-to-digital subsystems that recover the signal dynamics needed to characterize your data adequately.
- Frequency and timing measurement subsystems reading up to 550 MHz and down to 100 nanosec.
- Analog output capabilities to ±100V at 0.5A and ±50V at 5A.
- Interfaces for instrumentation and digital inputs and outputs you want to connect to the system.

Capabilities and Growth Potential

Key questions you, as a prospective data acquisition system user, must determine to your satisfaction are: "Will the system satisfy my immediate needs adequately? Will it keep up with changes in my applications and operations?" Hewlett-Packard realizes that your best assurance of continuing use and value from any system is the capability available when you purchase, combined with the system's ability to grow with your needs. The HP 9600A and HP 9600G Systems have been designed to provide this assurance.

WIDE CHOICE OF INSTRUMENTATION CAPABILITIES

A data acquisition system is absolutely useless to you if you can't equip it with the instrumentation capabilities that are needed to take your data. In our *9600 Computer Systems Configuring Guide* (HP literature request number 5952-1608), dated 9/72, we currently offer the following capabilities for use in HP 9600A and HP 9600G Systems:

- Three different subsystems for analog-to-digital measurement at rates from 18 kHz (14-bit resolution) to 100 kHz (10-bit resolution), with related data amplification, low-level multiplexing, and pacing options.
- Two different subsystems for analog-to-digital measurements at rates to 900 channels per second with 4-digit resolution. Resistance and true rms ac measurement capabilities are optional with one of these subsystems.
- Four different subsystems for measurement of time intervals (0.1 μs to 10^9 sec) and frequencies to 50 MHz or 550 MHz.
- Two different subsystems for high-resolution, integrating analog-to-digital measurements with capacity expandable to 1000 channels and optional multi-function capability (ac, resistance, and frequency measurements).
- Five different computer interfaces for digital input/output and for connection of your digital instruments to the system.
- Three different digital voltage sources offering output voltage to ±100 V dc, and current to 5 amperes for control of analog devices.

In addition to these standard subsystems, we can provide special subsystems to satisfy unique requirements of your applications.

OPTIONAL PERIPHERALS

System usability can be improved by adding to your HP 9600A or HP 9600G System the following peripherals:

- High Speed Line Printer – logs data and lists programs at up to 90 times the speed of the system teleprinter,* in 80- or 132-column format.
- Keyboard-Display Terminal – displays outputs from the system at 24 times the speed of the system teleprinter, operates noiselessly.
- High Speed Tape Punch – punches programs or data on paper tape at 12 times the speed of the system teleprinter; medium speed punch is available that operates at 7.5 times the speed of the teleprinter.
- Console Printer – logs data at three times the speed of the system teleprinter, prints 132 characters per line.
- Magnetic Tape Unit – records data on computer-compatible 7- or 9-channel magnetic tape at rates to 6000 times the tape punching speed of the system teleprinter.
- Display and Plotter Units – display or record data in graphical form for easy interpretation of trends, distributions, etc. Displays are available in 8 x 10 inch format or 7.5 x 9.5 cm format on a display that provides storage. The graphic plotter provides a 10 x 15 inch writing area and an average writing speed of 10 inches per second.

** System teleprinter speed is 10 characters per second.*

REMOTE TERMINALS

Your HP 9600A or HP 9600G System is usable as a remote terminal connected to a central system. Connection is completed via new serial data communication interfaces now available from Hewlett-Packard. Interfaces are offered for communication over distances up to 10,000 feet (3 kilometers) via two twisted, shielded pair wires, or for communication over much greater distances via modems and the switched telephone system.

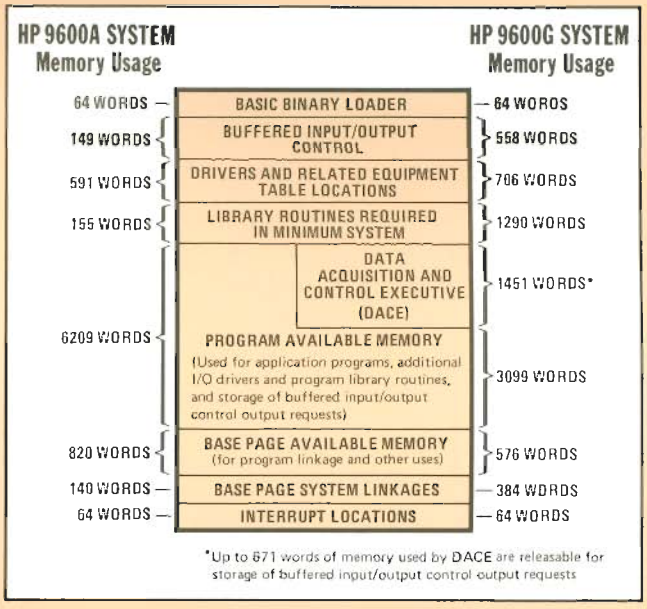
AMPLE INPUT/OUTPUT CAPACITY

The basic HP 9600A System has 12 I/O channels available for interfacing subsystems and peripherals; the HP 9600G System has 11 I/O channels available. This capacity can be increased to 43 channels in the HP 9600A System, 42 channels in the HP 9600G System by adding a 31-channel I/O extender.

Further expansion is possible through the use of the new HP Multiprogrammer subsystem, which can provide up to 240 analog output, digital input, and digital output channels driven through a single computer I/O channel. Through the use of the I/O extender and the multiprogramming subsystem, the potential for expansion of your HP 9600A or HP 9600G System is sufficient for virtually any application you may have.

EXPANDABLE MEMORY RESOURCES

The composite core map (Figure 1) shows the amount of memory available for subsystem and peripheral input/output driver programs, your application programs, additional library routines, and storage of input/output requests by the buffered input/output control section of the HP 9600G System. In the HP 9600A System, 6209 words are available for these uses. The comparable figure for the HP 9600G System is 3099 words. In many systems, additional memory will not be needed, but memory can be added. You can add 4K, 8K, 16K, or 24K words at any time, at your facility. Memory expandability of this magnitude provides ample reserve for system expansion.



COMPOSITE CORE MAP
Figure 1.

UPGRADABILITY

Because the HP 9600A and HP 9600G Systems are modular and largely self-configuring, new subsystems can be added or interchanged easily with existing subsystems to handle new applications as needed. In addition, these systems can be upgraded with respect to the sophisitcation and capabilities of the software they use. An HP 9600A System can be upgraded to an HP 9600G System by adding a time base generator and reconfiguring the system with the additional software. Similarly, an HP 9600A or HP 9600G System can be upgraded to an HP 9600E or HP 9600F Real Time Executive System by adding the desired disc memory, increasing computer memory capacity to 16,384 words, and reconfiguring with the appropriate software.

The "pay as you grow" design of the HP 9600A and HP 9600G Systems lets you start with your immediate needs and build to suit new requirements, right up to real-time executive systems and distributed systems.

Easy Implementation

The HP 9600A and HP 9600G Systems are supplied fully assembled, with the modular capabilities (measurement, display, etc.) you order for your data acquisition and control application. Since these are standard Hewlett-Packard instruments, you are not faced with custom design costs. Your involvement with implementation of these systems can be limited to preparation of application-related programs, configuration of these programs into the overall system, and connection of system inputs and outputs to signal sources and controlled equipment. This degree of involvement with implementation puts you in touch with the measurements and other actions of your system and gives you an opportunity to increase your knowledge and understanding of computer systems, all without overpowering you with an impossible implementation task.

HP 9600A and HP 9600G Systems give you a choice of three programming languages. You can use FORTRAN or ALGOL for fastest programming or HP Assembly language for most efficient coding. These systems also include a symbolic editor for easy correction of programs and a program "debug" package that helps you locate and correct programming errors or inconsistencies. The compilers and the HP Assembler all produce output in relocatable binary code, so program segments in different languages can be configured together and run as a single program.

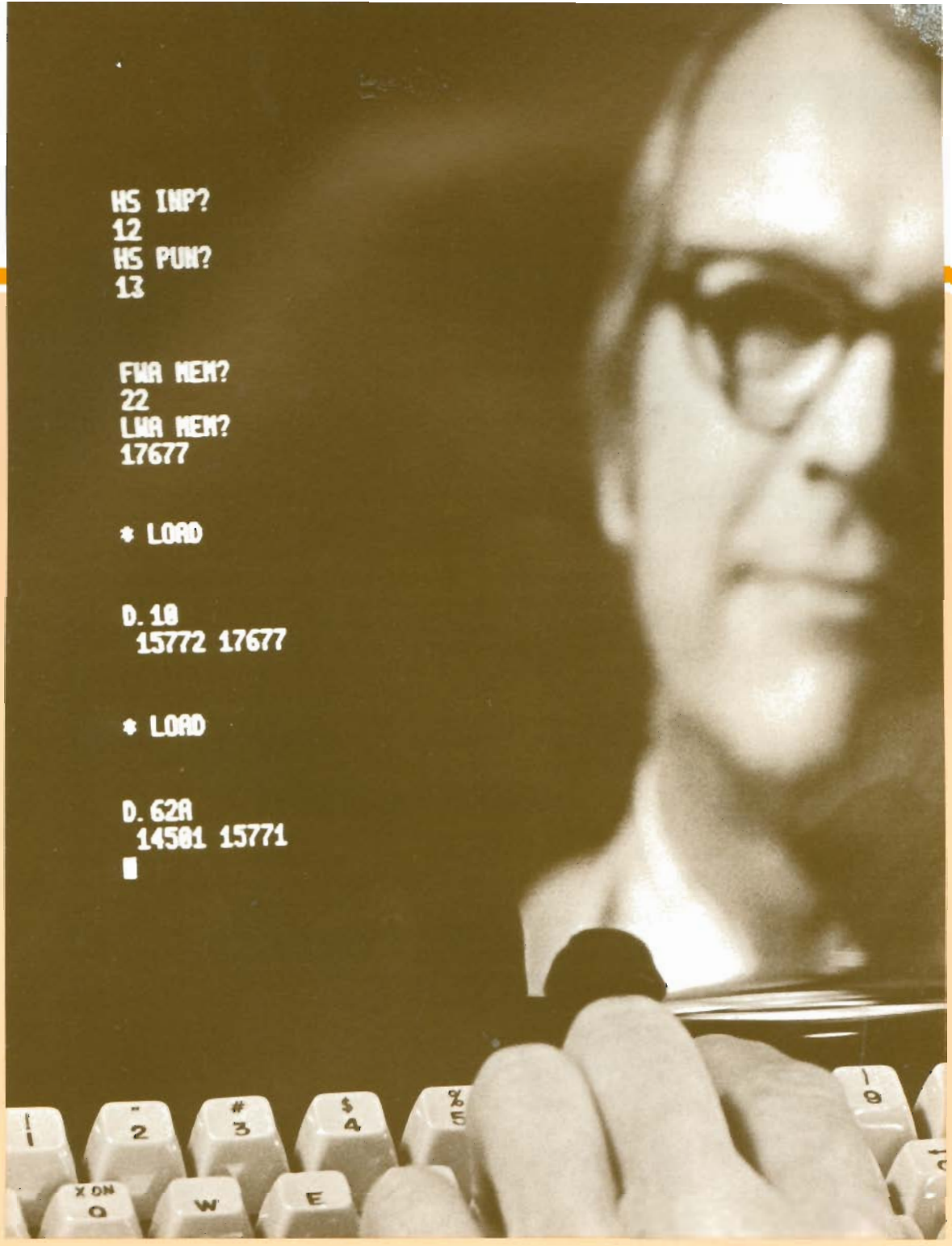
Control Routines (Drivers) are provided with 24 of the 30 different measurement subsystems and input/output peripherals that are available with HP 9600A/G Systems. The driver controls all details of input/output (I/O) for the subsystem or peripheral. A central Input/Output Control (IOC) system routes requests for measurements and input or output from your application program to the appropriate driver. The various driver programs are integrated into a customized operating system (the Basic Control System) for a particular size computer and particular hardware by the Prepare Control System in a process known as configuration. Because the driver subroutines are included with the great majority of subsystems, you are spared the time, effort, and expense of writing your own instrument and peripheral drivers.

All HP 9600A/G Systems are configured at the factory and checked out to confirm correct operation prior to shipment. A tape of the configured operating system is supplied with each HP 9600A/G System to minimize time and costs of getting your system into action. In most cases, all you have to do is load the configured operating system into the computer, add your application program(s) and required program library routines, and start operating. This means you can start using your system as soon as your first application program is ready.

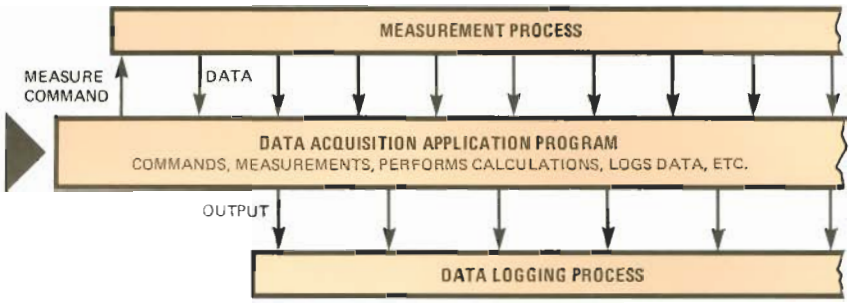
Reconfiguration is easy because HP 9600A/G Systems include a Prepare Control System (PCS) program which controls the configuration process. PCS asks for I/O channel assignments and tells you when to load operating system modules, supporting library routines, driver routines, and application programs. As this information is provided and the various program segments are loaded, *the system completes all required linkages between your program and the supporting routines, sets up all required linkages across "page" boundaries in memory, and assigns absolute addresses.* The system lists input/output channel assignments and the system's use of memory and punches a copy of the configured system in absolute, executable form. Because the system spares you the time-consuming drudgery of keeping track of absolute addresses and completing linkages, you can reconfigure your system with minimal loss of valuable operating time.

Device-Independent Programming also simplifies system implementation and upgrading. In HP 9600A/G Systems, input/output requests from your program refer to standard unit numbers for standard functions, such as keyboard input, list output, and punch output. Input/output requests to peripherals (magnetic tape, X-Y displays, or plotters, etc.) and measurement subsystems refer to installation unit numbers. The standard unit and installation unit numbers are associated with specific devices and specific computer input/output channel numbers via equipment tables that are created during system configuration. When equipment is changed, the equipment tables are changed to reflect the new hardware configuration, but the standard unit numbers and installation unit numbers do not change unless completely new capabilities add unit numbers. **This minimizes change to your programs** when you change the hardware configuration of your system, saving time and money.

HP Training teaches programming, configuration, and operation of your HP 9600A/G System. Two weeks instruction, included with these systems, provides training in FORTRAN and HP Assembly language programming and in configuration of the Basic Control System. The HP 9600G System also includes four days of *additional* instruction on instrument programming and on the use of the Data Acquisition and Control Executive. Both training courses provide ample hands-on experience.



Prepare Control System of HP 9600A and 9600G Systems leads you through the details of the system configuration process with a dialog like that shown above on the optional keyboard-display terminal. This is just one of the features of these systems that makes them easy to put to work on your applications.



Efficient Operation

Computers are inherently fast devices, capable of executing thousands of instructions per second while peripheral devices used for data logging and other purposes and instruments controlled by the computer are considerably slower. To assure that maximum use is made of all system resources, HP 9600A and HP 9600G Systems are designed to perform useful work while programmed actions of external devices are being completed. This approach maximizes the productivity of your system in your application.

Interrupt Mode Operation, used in the HP 9600A and HP 9600G Systems, promotes efficient use of system resources because measurements, calculations, and input/output can all take place concurrently. In this mode of operation, your program requests a measurement, then, without waiting for completion of that, it continues the next programmed actions (calculations on previously-acquired data, checking against limits, printout of results, etc.). The input/output control section of the system initiates the measurement and later transfers the resulting data to your program when the measurement is completed.

Calculations Are Completed Rapidly because hardware multiply-divide is standard in HP 9600A and HP 9600G Systems. In addition, these systems can be equipped with floating point hardware for even faster calculations. This optional hardware gives at least a five-fold increase in computing speed, compared with software floating point routines. This means your system can keep up with a large volume of work. Even if you don't need ultra-fast floating point calculations today, they provide a valuable reserve speed capacity that will be useful tomorrow.

SYSTEM COMPARISON

Capabilities	HP 9600A System	HP 9600G System
Interrupt mode operation	x	x
Output buffering		x
Program Library	x	x
Prepare Control System configuring	x	x
Device-independent programming	x	x
Program subdivision into tasks linked by executive		x
Real Time clock		x
Real Time scheduling of system tasks		x
Conversational access to program parameters		x
Optional floating point hardware	x	x

Extra Benefits of HP 9600G Systems

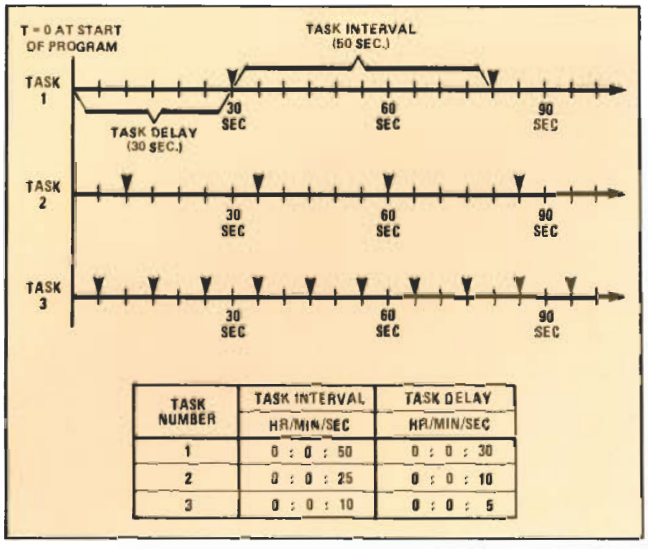
Actions or tasks such as measurement, calculations, checking against limits, and input/output are performed by the computer system under control of your application programs. Your program "tells" the system what to do, but usually doesn't tell the system when tasks are to be performed. This latter function of scheduling system operations is usually performed by an executive program. HP 9600G Systems provide such a program, the Data Acquisition and Control Executive (DACE), which offers additional benefits as described below.

Programming Is Simplified in the HP 9600G System because the overall data acquisition and control program may be subdivided into as many as 28 different, individually-scheduled tasks. The executive is the master program of the system, calling tasks according to the schedule you specify. Because tasks are considerably shorter than the total program, preparation, checkout, and "debugging" are relatively easy. The work of writing task programs can be divided among several people to minimize turnaround time where that is important. Because programming is simplified by subdivision of programs into tasks, you are able to accomplish more, more easily, and in less time.

Up-To-The-Second Real-Time Scheduling gives you the ability to correlate actions of the system with external events and the rates of change of data and external processes. With the HP 9600G System you are able to specify when and how often your programmed tasks are to be performed. For this purpose, the system maintains a real-time clock and an easily-changed schedule of intervals between tasks and delays to first task execution after system start (Figure 2).

Conversational Access to Program Parameters is a powerful feature of HP 9600G Systems that lets you modify your operational program to meet changing needs without modifying your original source language coding and without recompiling. The executive provides a 'manual' (off-line) mode in which task constants (channels to be sampled, comparison limits, task delay and interval times, etc.) can be examined and modified conversationally, using the system keyboard input unit. In practice, most tests follow a cut-and-try procedure in which equipment setups are modified as the test proceeds. For this reason, the ability to make quick, on-the-spot changes to the system parameters without recompiling shortens overall test setup times, and maximizes the information output of the system.

Output Buffering is an extension of interrupt mode operation provided in HP 9600G Systems. The system accepts output requests from your program, stores them if the output device is busy, and services them as the output device becomes available. This further increases the efficiency of operations in that measurements, processing, and logging of results can all be proceeding concurrently. Moreover, your program doesn't have to wait until an output device is free before proceeding. Thus, the slowing effect of peripheral devices is minimized and the potential operating rate of the system is maximized, speeding the processing and output of finished results.



TASK NUMBER	TASK INTERVAL HR/MIN/SEC	TASK DELAY HR/MIN/SEC
1	0 : 0 : 50	0 : 0 : 30
2	0 : 0 : 25	0 : 0 : 10
3	0 : 0 : 10	0 : 0 : 5

TASK SCHEDULING EXAMPLE
Figure 2.

The capabilities outlined above would require several man months of programming effort by expert programmers if they were not included in the HP 9600G System. Your purchase of the HP 9600G System brings you the benefits of thousands of dollars worth of programming at no additional cost to you.

System Software

The key to successful implementation of any data acquisition system is usually the capabilities of the software system supplied with the hardware. Without a strong software package centered around a strong central operating system, even the most state-of-the-art hardware is ineffective. In recognition of the key role played by software, Hewlett-Packard provides the most comprehensive software available for minicomputer controlled systems with the HP 9600A/G Systems. The HP 9600A/G Systems include software representing hundreds of man-years of software development work. The software supporting these systems embraces every requirement except application programming, including:

- *Software Input/Output*
- *Configuration and Operation*
- *Hardware Checkout and Diagnosis*
- *Programming Processing*
- *BASIC Language Operation*

Software Input/Output (SIO) System

The SIO system sets up communication between program processing software and input/output devices (teleprinter and tape reader in minimum systems). This includes:

1. Configured SIO System, a tape configured at the factory to work with your system so you'll be ready to start processing your programs as soon as your system is received.
2. SIO System Dump routine.
3. SIO Buffered Teleprinter Driver program.
4. SIO Tape Reader Driver program.
5. Additional SIO Drivers are supplied with optional peripherals, such as tape punches, magnetic tape units, and line printers.

Program Processing Software

Program processing software is used to translate your programs to relocatable binary form for use by your system. This software includes:

1. **FORTRAN Compiler** – translates FORTRAN programs.
2. **ALGOL Compiler** – translates ALGOL programs.
3. **Extended HP Assembler** – translates HP Assembly language programs.
4. **Cross-Reference Symbol Table Generator** – prints a cross reference list of all symbols appearing in an HP Assembly language program. This helps isolate errors and inconsistencies in assembly language programs.
5. **Symbolic Editor** – used to modify FORTRAN, ALGOL, or HP Assembly language programs.

Configuration and Operational Software

The configuration and operational software converts relocatable programs to absolute form for execution, provides for "debugging" programs, and controls system input and output. In HP 9600G Systems, this software also schedules system operations in real time and provides for changing constants within programs in the system without recompiling or reassembling. This software includes:

1A. Configured Basic Control System, a tape configured at the factory to work with your HP 9600A System so you'll be ready to add your application programs and start actually using your system as soon as your programs are ready. (HP 9600A System only.)

1B. DACE-Configured Basic Control System, a tape configured at the factory to work with your HP 9600G System so you'll be ready to add your application programs and start actually using your system as soon as your programs are ready. (HP 9600G System only.)

2. Prepare Control System gives you the ability to modify or expand your system at your facility, without special assistance, and with little or no change of programs.

3. Relocating Loader assembles your program, related subroutines, peripheral and subsystem driver programs, and supporting library routines into the complete operational package that is your total system.

4. BCS Teleprinter Driver program D.00 controls teleprinter input/output.

5. BCS Tape Reader Driver program D.01 controls tape reader input.

6. Additional BCS Drivers are supplied with other peripherals and subsystems you order for your system, providing a complete input/output control capability when configured with the Input/Output Control System (HP 9600A System) or the Buffered Input/Output Control System (HP 9600G System).

7A. Input/Output Control System (HP 9600A System only) coordinates all input/output operations in interrupt mode for efficient use of system resources (see page 8).

7B. Buffered Input/Output Control System (HP 9600G System only) coordinates all input/output operations in interrupt mode and stores output requests until they can be serviced for most efficient use of system operating time and resources (see page 9).

8. Relocatable Program Library provides a FORTRAN/ALGOL formatter, 47 mathematical subroutines, and 7 utility subroutines which are callable from FORTRAN, ALGOL, or HP Assembly language programs plus 6 additional mathematical subroutines which are callable from FORTRAN and HP Assembly language programs only (see page 11, facing).

9. Debugging Routine executes programs interpretively so that programmer can trace their execution and easily locate errors or inconsistencies.

10. BCS Time Base Generator Driver program D.43 (HP 9600G System only) controls time base generator and passes time information to the Data Acquisition and Control Executive used for scheduling operations in HP 9600G Systems. Also provides time information on request from your application program.

11. Data Acquisition and Control Executive (DACE) Library provides HP 9600G System with the routines that:

    a) Set up changes pf program constants, including system time scheduling, without recompiling.

    b) Call up task programs according to the real time schedule specified by the system operator.

BASIC Language Software

The BASIC language software provides conversational programming and execution of general purpose scientific and engineering calculations and data processing. In HP 9600A and HP 9600G Systems, this software is loaded into the computer in place of the standard system software for use when data acquisition is not in progress. This software includes:

1. BASIC, an interpreter that provides conversational programming and operation of the system for computations, data processing, and output of results. BASIC communicates only with the tape reader, keyboard input unit, and optional tape punch.
2. Prepare Basic System, a program that is used to configure the BASIC interpreter to operate in a particular system. The configured BASIC interpreter may be punched out on tape.

Hardware Checkout and Diagnostic Software

The Hardware Checkout and Diagnostic Software is provided to minimize system down-time by speeding and simplifying isolation of any system malfunction. This software includes these routines:

1. Low Memory Pattern Test
2. High Memory Pattern Test
3. Memory Parity Check Test
4. Power Fail Diagnostic
5. Alter-Skip Instruction Test
6. Memory Reference Instruction Test
7. Shift-Rotate Instruction Test
8. Low Memory Address Test
9. High Memory Address Test
10. Extended Arithmetic Unit Test
11. Interrupt Test
12. Memory Protect Test
13. Buffered Teleprinter Test
14. Tape Reader Test
15. Tape Reader Interface Card Diagnostic
16. Time Base Generator Test – HP 9600G System only
17. DACE AXEPT Verification – HP 9600G System only
18. Additional test and interface diagnostic routines are supplied with optional peripherals and with the data acquisition, digital input/output, and stimulus subsystems in your system.

Powerful Program Library

PROGRAM LIBRARY Subroutines and Functions	CALLABLE FROM FTN	ALGOL	ASMB
FORMATTER Structures input/output	•	•	•
ABS Calculates absolute value of a real X	•	•	•
AIMAG Extracts imaginary part of a complex X	•	•	•
ALOG Calculates natural log of a real X	•	•	•
AMOD Calculates real remainder of X/Y for real X & Y	•	•	•
ATAN Calculates arctangent of real X	•	•	•
ATAN2 Calculates real arctangent of Y/X for real X & Y	•	•	•
CABS Calculates real absolute value of complex X	•	•	•
CADD Adds complex X to complex Y	•	•	•
CDIV Divides complex X by complex Y	•	•	•
CMPLX Combines real X and imaginary Y into complex Z	•	•	•
CMPLY Multiplies complex X by complex Y	•	•	•
CONJG Forms conjugate Y of complex X	•	•	•
CSQRT Calculates complex square root of complex X	•	•	•
CSUB Subtracts complex Y from complex X	•	•	•
DABS Calculates absolute value of double real X	•	•	•
DATAN Calculates double real arctangent of double real X	•	•	•
DATN2 Calculates double real arctangent of two double real numbers (Y/X)	•	•	-
DBLE Converts real X to double real Y	•	•	•
DCOS Calculates double real cosine of double real X	•	•	•
DDINT Truncates a double real X to a double real Y	•	•	•
DIM Calculates positive difference between real X and Y	•	•	•
DMOD Calculates double real remainder of two double real values	•	•	•
DSIGN Transfers sign of a double real X to a double real Y	•	•	•
DSIN Calculates double real sine of double real X	•	•	•
ENTIE Calculates greatest integer not algebraically exceeding a real X		•	•
ENTIX Calculates ENTIER of double real X	•	•	•
EXP Calculates e^X where X is real	•	•	•
FADSB Adds real X to real Y	▲	▲	•
FDIV Divides real X by real Y	▲	▲	•
FLOAT Converts integer I to real X	•	•	•
FMP Multiplies real X by real Y	▲	▲	•
IABS Calculates absolute value of integer I	•		•
IAND Takes logical product of integers I and J	•		•
IDIM Calculates positive difference between integers I and J	•	•	•

PROGRAM LIBRARY Subroutines and Functions	CALLABLE FROM FTN	ALGOL	ASMB
IDINT Truncates double real X to an integer J	•	•	•
IFIX Converts real X to integer I	•		•
IOR Takes logical inclusive OR of inteters I and J	•		•
ISIGN Calculates sign of real or integer Z times absolute value of integer I	•		•
MOD Calculates integer remainder of I/J for integers I and J	•	•	•
MXMND Calculates maximum or minimum of series of double real values	•	•	•
MXMNI Calculates maximum or minimum of series of integer values	•	•	•
MXMNR Calculates maximum or minimum of series of real values	•	•	•
REAL Extracts real part of a complex X	•	•	•
SICOS Calculates sine or cosine of a real X (radians)	•	•	•
SIGN Calculates sign of real or integer 2 times real X	•		•
SINGL Converts double real X to real Y	•	•	•
SQRT Calculates square root of real X	•	•	•
TAN Calculates tangent of a real X (radians)	•	•	•
TANH Calculates hyperbolic tangent of a real X	•	•	•
XADSB Double real addition and subtraction	•	•	•
XDIV Divides double real X by double real Y	•	•	•
XMPY Multiplies double real X by double real Y	•	•	•
XPOLY Evaluates double real polynomial	•	•	•
CLRIO Clears system to make all I/O devices available for start of a new operation	•	•	•
CODE Provides internal conversion according to FORMAT from one area in core memory to another area	•	•	•
ENDIO Delays further program execution until all current I/O operations are completed	•	•	•
ISSW Sets sign bit of computer A-register equal to bit N of computer switch register	•	•	•
LEADR Produces consecutive feed frames on punched tape to serve as leader	•	•	•
MAGTP Performs rewind, read/write a block of data, write a gap, standby, and clear I/O functions for a magnetic tape unit	•	•	•
PTAPE Positions magnetic tape on tape unit by spacing forward or backward "N" files and/or records	•	•	•

▲*Appropriate calls to FADSB, FDIV, and FMP subroutines are automatically generated by the FORTRAN or ALGOL compiler whenever a plus, minus, division (/), or multiplication (•) sign is encountered while compiling your source program.*

For more information, call your local HP Sales Office or East (210) 265-5000 • Midwest (312) 677-0400 • South (404) 436-6181 • West (213) 877-1282. Or write: Hewlett-Packard, 1501 Page Mill Road, Palo Alto, CA 94304. In Europe: P.O. Box 85, CH-1217 Meyrin 2, Geneva, Switzerland. In Japan: YHP, 1-59-1, Yoyogi, Shibuya-Ku, Tokyo, 151.

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